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Self Balancing Platform

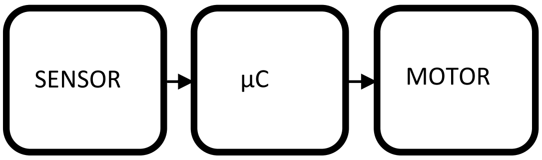
Siddhesh C. Narkar, Siddhesh R.Bhalekar, Tushar K. Nawge, Keshav H. Parab, Prafulla V.Patil

Abstract:- The goal of the project is to create a platform that would balance itself at any given arbitrary initial position and initial velocity. The platform will tilt along the X and Y axis in order to balance itself parallel to earth surface. This project utilizes a Microcontroller, Accelerometer, Platform and DC Motor.

I. INTRODUCTION

SELF BALANCING PLATFORM is the basic concept use in auto pilot mode in aero plane. In this airplane balances itself in air without help of pilot and try to remain parallel with respect to ground level. In self balancing platform the main components are position sensors, microcontroller and dc motor. Depending upon change in platform movement controlling action is performed. Considering change in platform position due to some artifacts this change is sensed by position sensor (accelerometer) and signal is send to microcontroller. Depending upon the amount of change in position of Platform and direction controller energies respective motor to bring platform back to is originally/ stable position. Two dc motor are attached to platform one from top end and other from bottom with help of string such that it is parallel with respect to ground level.

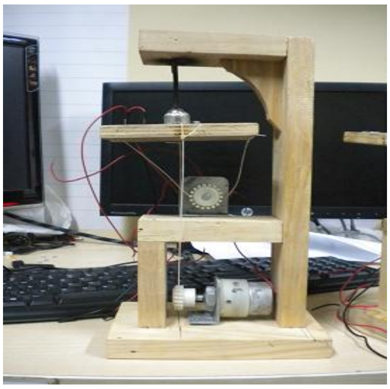
II. BLOCK DIAGRAM

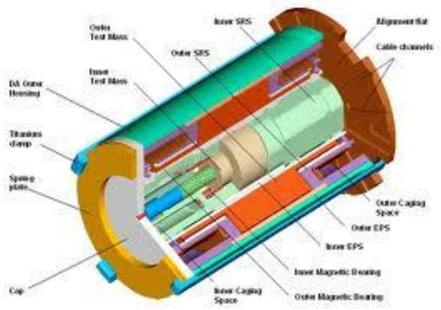


Block diagram module consist of:
1. Accelerometer
2. Microcontroller
3. DC Motor

III. POSITION SENSOR

Accelerometer





A. *Introduction*

One of the most common inertial sensors is the accelerometer Dynamic sensor capable of a vast range of sensing. Accelerometers are available that can measure acceleration in one, two, or three orthogonal axes. They are typically used in one of three modes: As an inertial measurement of velocity and position; As a sensor of inclination, tilt, or orientation in 2 or 3 dimensions, as referenced from the acceleration of gravity(1 g = 9.8m/s2); As a vibration or impact (shock) sensor. There are considerable advantages to using an analog accelerometer as opposed to an inclinometer such as a liquid tilt sensor inclinometers tend to output binary information (indicating a state of on or o_), thus it is only possible to detect when the tilt has exceeded some thresholding angle.

B. Principles of Operation:

Most accelerometers are Micro-Electro-Mechanical Sensors (MEMS). The basic principle of operation behind the MEMS accelerometer 9 is the displacement of a small proof mass etched into the silicon surface of the integrated circuit and suspended by small beams. Consistent with Newton's second law of motion (F = ma), as an acceleration is applied to the device, a force develops which displaces the mass. The support beams act as a spring, and the (usually air) trapped inside the IC acts as a damper, resulting in a second order lumped physical system. This is the source of the limited operational bandwidth and non-uniform frequency response of accelerometers. For more information, see reference to Elwenspoek, 1993.

C. Types of Accelerometer:

There are several different principles upon which an analog accelerometer can be built. Two very common types utilize capacitive sensing and the piezoelectric effect to sense the displacement of the proof mass proportional to the applied acceleration.

D. Specifications

A typical accelerometer has the following basic specifications:

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1.) Analog/digital.
2.) Number of axes.
3.) Output range (maximum swing).
4.) Sensitivity (voltage output per g).
5.) Bandwidth.
6.) Amplitude stability.

E. Analog vs. digital:

The most important specification of an accelerometer for a given application is its type of output. Analog accelerometers output a constant variable voltage depending on the amount of acceleration applied. Digital accelerometers output a variable frequency 10 square wave, a method known as pulse-width modulation. A pulse width modulated accelerometer takes readings at a rate, typically 1000 Hz (though this may be user-configurable based on the IC selected). The value of the acceleration is pro proportional to the pulse width (or duty cycle) of the PWM signal. For use with ADCs commonly used for music interaction systems, analog accelerometers are usually preferred.

F. Number of axes:

Accelerometers are available that measure in one, two, or three dimensions. The most familiar type of accelerometer measuresacross two axes. However, three-axis accelerometers are increasingly common and inexpensive.

G. Output range:

To measure the acceleration of gravity for use as a tilt sensor, an output range of 1.5 g is sufficient. For use as an impact sensor, one of the most common musical applications, 5 g or more is desired.

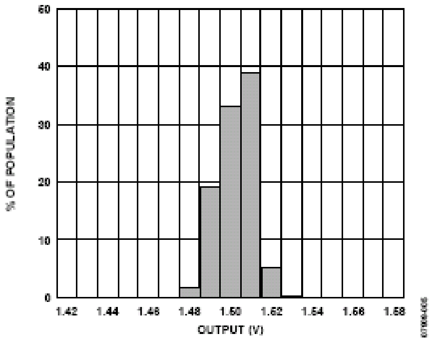

Figure 3. X-Axis Zero g Bias at 25°C, $V_S = 3$ V

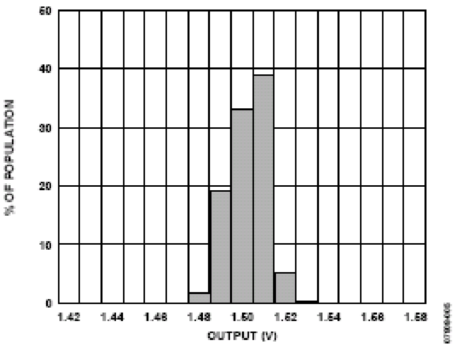

Figure 3. X-Axis Zero g Bias at 25°C, $V_S = 3$ V

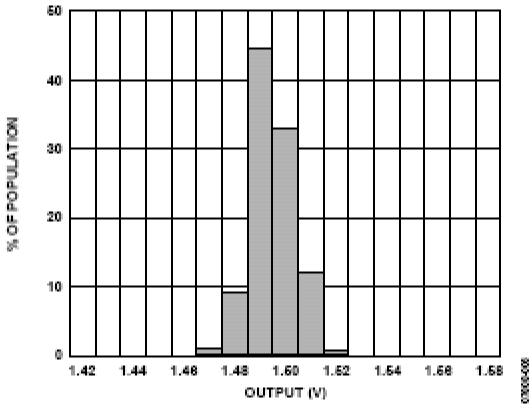

Figure 4. Y-Axis Zero g Bias at 25°C, $V_S = 3$ V

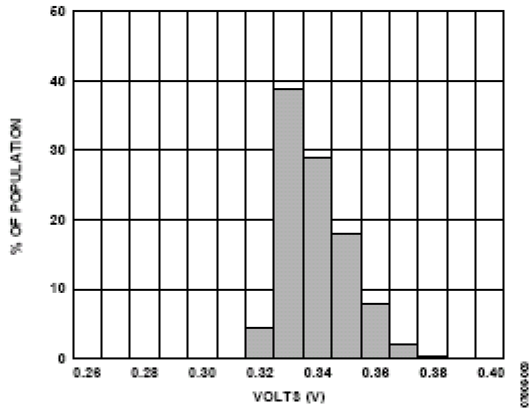

Figure 7. Y-Axis Self-Test Response at 25°C, $V_S = 3$ V

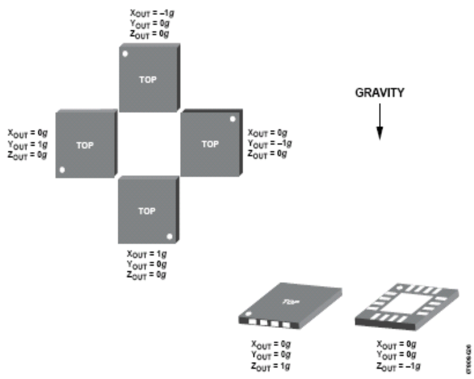

Figure 24. Output Response vs. Orientation to Gravity

IV. DC MOTOR

A DC motor is an electric motor that runs on direct current (DC) electricity.DC motors were used to run machinery, often eliminating the need for a local steam engine or internal combustion engine. DC motors can operate directly from rechargeable batteries, providing the motive power for the first electric vehicles. Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines. Modern DC motors are nearly always operated in conjunction with power electronic devices.

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There are main two types of DC MOTOR:

1.) BRUSH DC MOTOR

2.) BRUSHLESS DC MOTOR

The brushed DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary magnets
(Permanent or electromagnets), and rotating electrical magnets. Like all electric motors or generators, torque is produced by the principle of Lorentz force, which states that any current-carrying conductor placed within an external.

V. CONTROLLER

The microcontroller is the heart of any control system; therefore its proper selection is very important. There are many microcontroller families and many different type of microcontroller with wide range in applications. The AVR was one of the first microcontroller families to use on-chip ash memory for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time. The AVR is a modified Harvard architecture machine where program and data are stored in separate physical memory systems that appear in different address spaces, but having the ability to read data items from program memory using special instructions.

Features required by us:

1.) Analog to digital converter.
2.) Digital to analog converter.
3.) Comparator.
4.) Fast execution.
5.) Easy in programming.

VI. SCOPE OF PROJECT

1 .Self balancing robo.
2. Videogamming.
3. Photography.
4. Buliding construction

VII. CONCLUSION

Our final project is capable of stabilizing a platform at the proximity of parallel to earth. Improvements can be made by using alternative method to detect the platform position, stronger servos, or adding op-amp to filter the signal.

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